INSTRUCTIONS

For Installation

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INTRODUCTION

⚠ CAUTION

The equipment covered by this publication must be selected for a specific application and it must be installed, operated, and maintained by qualified persons who are thoroughly trained and who understand any hazards that may be involved. This publication is written only for such qualified persons and is not intended to be a substitute for adequate training and experience in safety procedures for this type of equipment.

The S&C Switch Operator—Type CS-1A is a high-speed operator having an operating time of 1.5 seconds maximum. It is expressly designed for power operation of S&C Circuit-Switchers—Mark V, as indicated in the table below.

High-speed, high-torque power operation of S&C Circuit-Switchers—Mark V, by means of the S&C Switch Operator—Type CS-1A, is essential in order to attain the two-time duty-cycle fault-closing ratings of 30,000 amperes rms three-phase symmetrical, 76,500 amperes peak for Vertical-Break Style and Integer Style models; and two-time duty-cycle fault-closing ratings of 40,000 amperes rms three-phase symmetrical, 102,000 amperes peak for Center-Break Style models.

SWITCH OPERATORS—Type CS-1A

Application		Motor and Control Voltage	Maximum Operating Time, Seconds①	Minimum Locked-Rotor Torque at Rated Control Voltage, Inch-Lbs.	Accelerating Current, Amperes	Catalog Number	Schematic Wiring Diagram Drawing Number
High-Voltage Device	Style and Rating of High-Voltage Device						
S&C Mark V◆ Circuit-Switcher without Shunt-Trip Device	Integer, 34.5 thru 69 kv	48 v dc	1.5	21 500	80	38845R4-A	CDR-3112R2
		125 v dc	1.5	21 500	30	38845R4-B	
	Vertical-Break, 34.5 thru 161 kv Center-Break, 230 and 345 kv, 3 gaps	115 v 60 hz	1.5	18 000	46	38845R4-D	CDR-3123R2
S&C Mark V◆ Circuit-Switcher with Shunt-Trip Device	Integer, 34.5 thru 69 kv	48 v dc	1.5	21 500	80	38846R5-AHP	CDR-3183
		125 v dc	1.5	21 500	30	38846R5-B■	CDR-3184▲
	Vertical-Break, 34.5 thru 161 kv Center-Break, 230 and 345 kv, 3 gaps						

① Based on minimum battery and external control wire-size requirements specified in S&C Data Bulletin 719-60; operating time will be less if larger-than-minimum battery size and/or external control wire size is utilized

◆ *The Type CS-1A switch operator is also suitable for use with equivalent models of Mark II, Mark III, and Mark IV Circuit-Switchers.*

■ Catalog Number 38858R1-B, for applications where the Circuit-Switcher is used in conjunction with an S&C Automatic Control Device, unless the switch operator is ordered with the optional Shunt-Trip Contactor and Time-Delay Relay accessory, Catalog Number Suffix "-HP." In this instance, the catalog number is 38846R5-BHP.

▲ CDR-3183 for Catalog Number 38846R5-BHP. CDR-3195 for Catalog Number 38858R1-B.

Supersedes Instruction Sheet 719-500 dated *10-28-85* ©1993

INTRODUCTION — Continued

Power operation of S&C Circuit-Switchers—Mark V, by means of the S&C Switch Operator—Type CS-1A, also provides opening and closing without hesitation under ¾-inch ice formation for Vertical-Break and Integer Style models, 1½-inch ice formation for Center-Break Style models; close interphase simultaneity; long life of fault-closing contacts under normal operating duties; and avoidance of excessive switching transients due to prolonged or unstable prestrike arcing.

Because of its high-speed operation, the S&C Switch Operator—Type CS-1A is not suitable for use with switches of other manufacture.

For 6-gap S&C Circuit-Switchers, the S&C Switch Operator—Type CS-2A is required.

For S&C Circuit-Switchers—Type A and Type G, Vertical-Break Style, having reciprocating operating mechanisms, the S&C Switch Operator—Type CS-10 is required.

For S&C Alduti-Rupter® Switches—Outdoor Distribution and S&C Alduti-Rupter Switches with Power Fuses—Outdoor Distribution, S&C Switch Operators—Types AS-1A and AS-10 are available.

For S&C Line-Rupters™, the S&C Switch Operator—Type LS-2 is available.

For switches of other manufacture, the S&C Switch Operator—Type LS-1 is available. The LS-1 is a low-speed operator with an operating time of 4 to 7 seconds. It is designed for power operation of outdoor high-voltage disconnects and interrupter switches for which this low operating speed is appropriate.

S&C Switch Operators—Type CS-1A include the following features as standard:

- Built-in internal decoupling mechanism, operable by integral external selector handle, with padlocking provisions and automatic mechanical locking of output shaft. Laminated safety-plate window permits "visible air-gap" verification of complete disengagement of output shaft.
- Open-close pushbuttons, externally operable, with padlockable cover.
- Built-in nonremovable, foldaway manual operating handle.
- Mechanical position indicators for both switch operator and Circuit-Switcher "open" and "closed" positions.
- Non-reset electric operation counter.
- Laminated safety-plate window for inspection of built-in internal decoupling mechanism, mechanical position indicators, and operation counter (and position-indicating lamps, if furnished as accessories).
- Foolproof recoupling. Impossible with position-indexing drums to couple the switch operator and the Circuit-Switcher "unsynchronized."
- Fingertip precision adjustment of output-shaft rotation using self-locking spring-biased cams.
- Eight-pole auxiliary switch, coupled to motor, with fingertip precision adjustment of individual contacts using self-locking spring-biased cams.

- Antifriction bearings throughout; tapered roller bearings for all high-torque gear-train shafts.
- Two-pole pull-out fuseholders for motor, space-heater, and (if applicable) shunt-trip circuits.
- Weatherproof, dustproof enclosure, equipped with 120/240-volt ac space heater, factory-connected for 240-volt ac operation. Can readily be field-reconnected for 120-volt ac operation.
- Tamper-resistant design—welded enclosure; baffled louvers; gasketed, flanged door openings; cam-action door latch; provisions for padlocking.
- Foul-weather accessibility to interior of enclosure. Access is by door rather than by removal of entire enclosure.

Switch operator catalog numbers are suffixed with one or more letters. The first letter following the catalog number designates the motor and control voltage:

Suffix	Voltage
-A	48 volts dc
-B	125 volts dc
-D■	115 volts 60 hz

■ Not applicable to Catalog Numbers 38846R5 or 38858R1.

Other suffix letters which may be added to the switch operator catalog number indicate the inclusion of optional accessories as follows:

ACCESSORIES

Item	Suffix Added to Switch Operator Catalog Number
Shunt-Trip Contactor and Time-Delay Relay, minimize control-current inrush by energizing shunt-trip device and switch operator motor in sequence①②	-HP
Deletion of Externally Operable Open-Close Pushbuttons	-J
Space Heater Thermostat	-K
Key Interlock with Switch, locks Circuit-Switcher open and disconnects motor-control circuit	-L
Position-Indicating Lamps (one red, one green), mounted inside the enclosure③	-M
Extra Auxiliary Switch (individually adjustable contacts), 4-PST (coupled to motor)	-Q
Duplex Receptacle and Convenience-Light Lampholder with Switch	-V
Extra Auxiliary Switch (individually adjustable contacts), 8-PST (coupled to Circuit-Switcher)④	-W
Remote-Control Blocking Switch, prevents remote operation of switch operator when the protective cover for the externally mounted open-close pushbuttons is open	-Y
Extra Auxiliary Switch (individually adjustable contacts), 12-PST (coupled to Circuit-Switcher)④	-Z

① Available as an optional accessory only with S&C Switch Operator Catalog Number 38846R5-B; included as standard equipment with Catalog Number 38846R5-AHP. Permits use of minimum-size control wire. Refer to S&C Data Bulletin 719-60.

② Not available with S&C Switch Operator Catalog Number 38858R1-B.

③ Not available in applications utilizing an S&C Circuit-Switcher Relay and Control Pack.

④ The 8-PST extra auxiliary switch (suffix "-W") cannot be furnished if the 12-PST version (suffix "-Z") is specified, and vice versa.

INSTALLATION

Step 1

Mount the switch operator as indicated on the erection drawing. Then attach a flexible coupling to the output shaft of the switch operator. See Figure 1. Thread the attachment bolts through the flexible coupling plate and through the coupling flange on the output shaft. Tighten the bolts to draw the flexible plate flush against the flange; this will deform the threads in the flexible plate, resulting in a binding, nonslip connection. Install and tighten the self-locking nuts. *Do not* use lockwashers with the attachment bolts.

Remove the clamp bolts and set aside the detachable half of the flexible coupling.

Make certain that the cutting tips of the piercing set screws do not protrude through the body of the flexible coupling on the switch operator output shaft and the flexible coupling attached to the shaft extending from the gearbox on the Circuit-Switcher pole-unit base.

Install the vertical shaft between the flexible coupling that is attached to the shaft extending from the gearbox on the Circuit-Switcher pole-unit base and the flexible coupling attached to the switch operator output shaft. At the *gearbox end* of the vertical shaft, tighten the flexible coupling clamp bolts equally so that the clamp pulls down evenly. Then tighten the associated piercing set screws, piercing the shaft, and continue turning until a firm resistance is felt.

At the switch operator output shaft, replace the detachable half of the flexible coupling, but *do not tighten* the clamp bolts or the piercing set screws at this time.

Step 2

Mark the conduit-entrance location for the control-circuit wiring on the conduit-entrance plate in the bottom of the switch operator enclosure. See Figure 2.

Remove the conduit-entrance plate and cut out the necessary opening. (If the Circuit-Switcher is equipped with optional S&C Shunt-Trip Device, an entrance cutout for an additional one-inch conduit should also be made at this time.)

Replace the conduit-entrance plate and make up the entrance fittings. Apply sealing compound (provided with each switch operator) when replacing the conduit-entrance plate. Verify that the entrance fittings are properly sealed to prevent water ingress.

Step 3

If Circuit-Switcher is equipped with the optional shunt-trip device, install the one-inch-diameter conduit between adjacent shunt-trip solenoid housings and

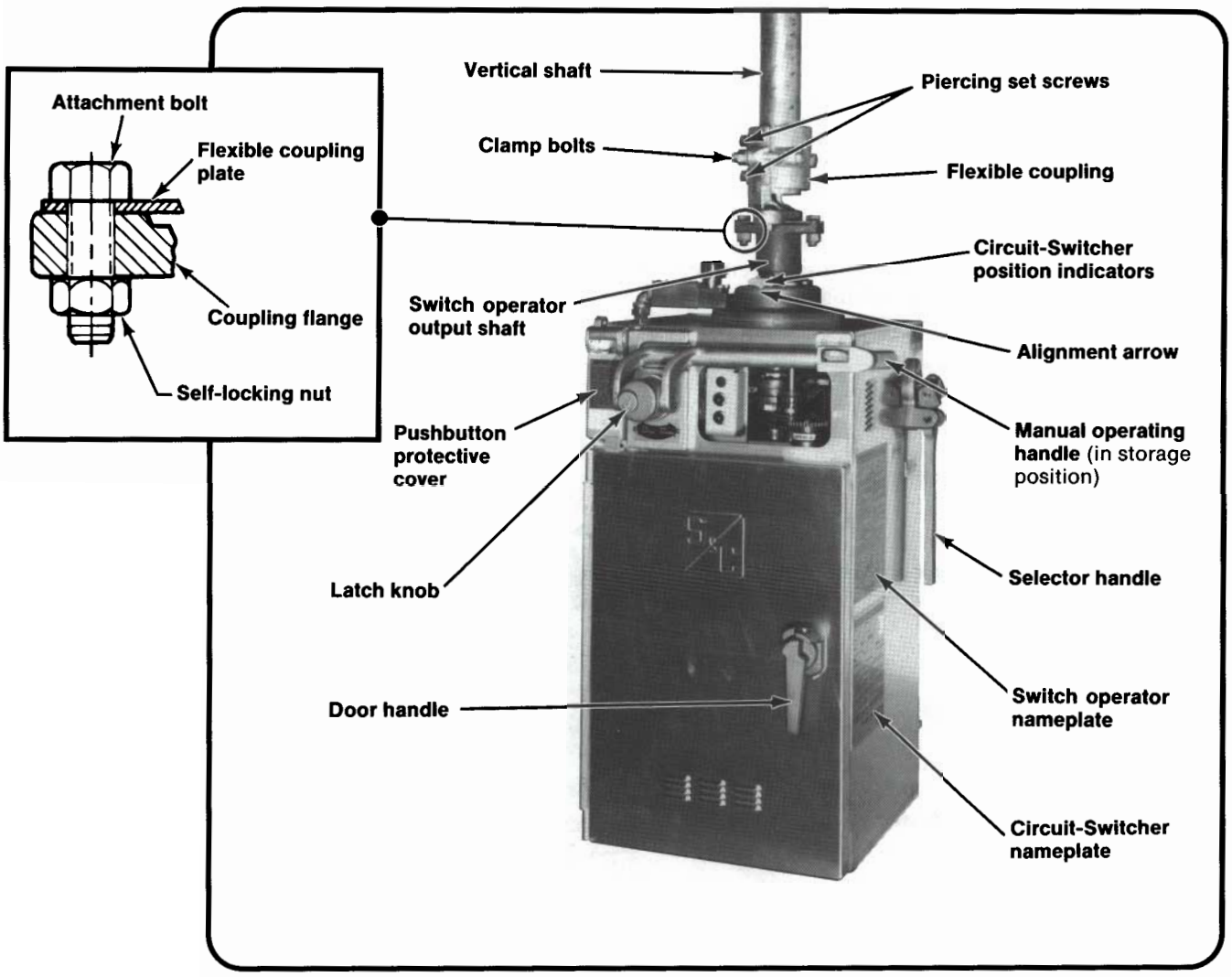


Figure 1. Exterior view of switch operator.

INSTALLATION — Continued

between one solenoid housing and the switch operator. Refer to S&C Instruction Sheet 711-600.

Step 4

⚠ CAUTION

To avoid accidental energizing of the operator after the external connections have been completed, remove the two-pole pull-out fuseholders for the motor, space-heater, and (if applicable) shunt-trip circuits. See Figure 2. Reinsert the fuseholders only when indicated in the steps which follow.

Remove the blocking from the motor contactors.

Connect the external control-circuit wiring (including space-heater source leads) to the terminal blocks of the switch operator in accordance with the wiring diagram furnished.

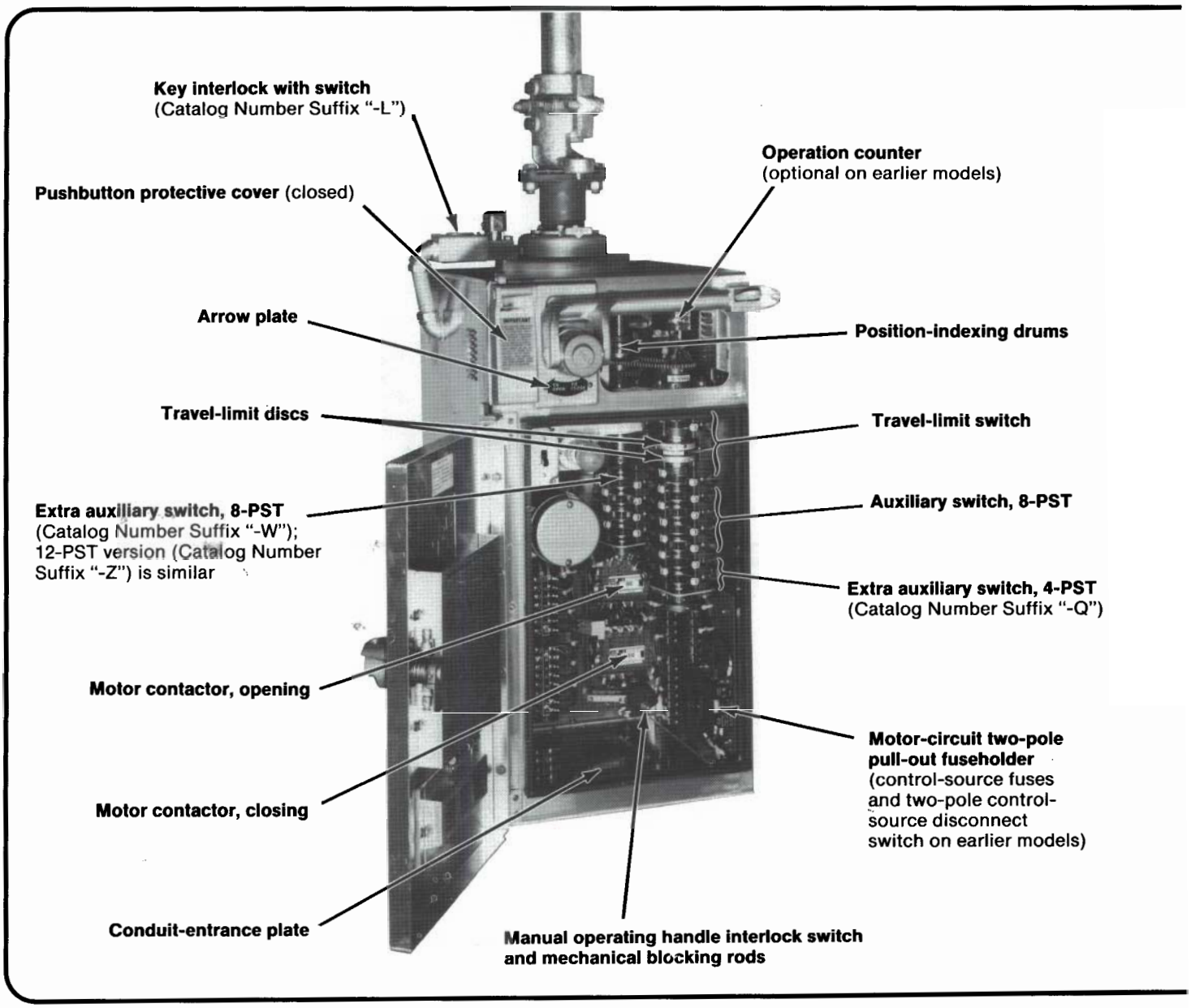

Key interlock with switch (Catalog Number Suffix "-L")
Pushbutton protective cover (closed)
Arrow plate
Travel-limit discs
Extra auxiliary switch, 8-PST (Catalog Number Suffix "-W"); 12-PST version (Catalog Number Suffix "-Z") is similar
Motor contactor, opening
Motor contactor, closing
Conduit-entrance plate
Operation counter (optional on earlier models)
Position-indexing drums
Travel-limit switch
Auxiliary switch, 8-PST
Extra auxiliary switch, 4-PST (Catalog Number Suffix "-Q")
Motor-circuit two-pole pull-out fuseholder (control-source fuses and two-pole control-source disconnect switch on earlier models)
Manual operating handle interlock switch and mechanical blocking rods

Figure 2. Interior views of switch operator.

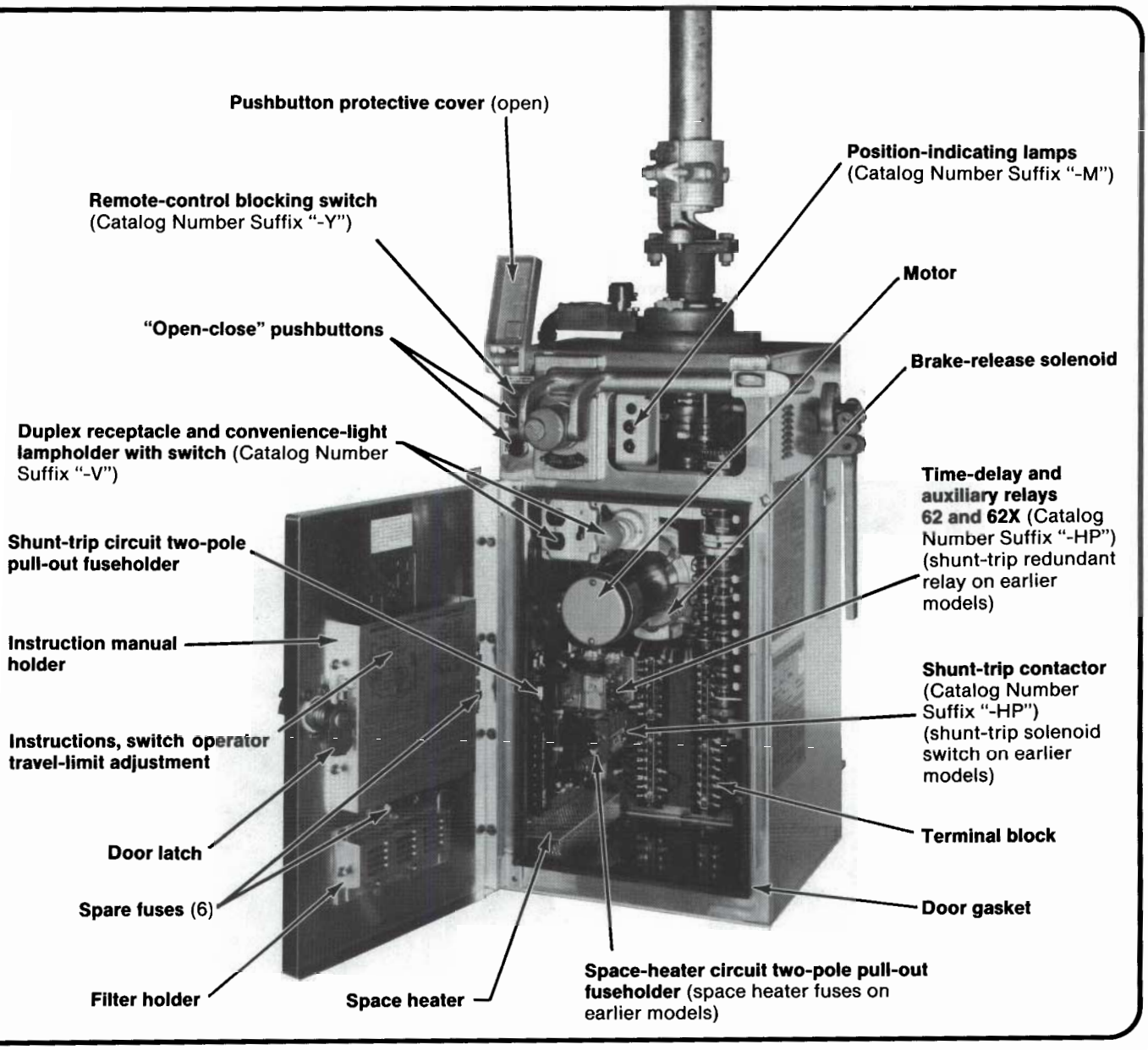
⚠ CAUTION

Unauthorized changes should not be made in the wiring of this switch operator. Should a control-circuit revision appear desirable, it should be made only on the authority of a revised wiring diagram which has been approved by both the user and S&C Electric Company.

⚠ IMPORTANT

Observe recommended minimum wire-size requirements for the control-circuit wiring, and the shunt-trip device wiring where applicable, as shown in S&C Data Bulletin 719-60 and on the switch operator schematic wiring diagram furnished.

Note: Wiring must be complete and adequate control voltage must be available at the switch operator before checkout by an S&C factory specialist.


Pushbutton protective cover (open)
Position-indicating lamps (Catalog Number Suffix "-M")
Remote-control blocking switch (Catalog Number Suffix "-Y")
Motor
"Open-close" pushbuttons
Brake-release solenoid
Duplex receptacle and convenience-light lampholder with switch (Catalog Number Suffix "-V")
Time-delay and auxiliary relays 62 and 62X (Catalog Number Suffix "-HP") (shunt-trip redundant relay on earlier models)
Shunt-trip circuit two-pole pull-out fuseholder
Instruction manual holder
Shunt-trip contactor (Catalog Number Suffix "-HP") (shunt-trip solenoid switch on earlier models)
Instructions, switch operator travel-limit adjustment
Terminal block
Door latch
Spare fuses (6)
Door gasket
Filter holder
Space heater
Space-heater circuit two-pole pull-out fuseholder (space heater fuses on earlier models)

MANUAL OPERATION

Before proceeding further, the user should become familiar with the operation of the manual operating handle and the selector handle, as described on the switch operator nameplate on the right-hand side of the enclosure and in Steps 5, 6, and 7 below. See Figures 3 and 4.

⚠ CAUTION

Manual closing of an *energized* Circuit-Switcher is not recommended because of the possibility of closing into a fault. Manual opening of an energized Circuit-Switcher is permissible. Once the opening operation has been initiated, however, it should be completed with dispatch. Cranking should continue until the Circuit-Switcher is fully open, as indicated by resistance which will be felt as the Circuit-Switcher power train progresses to its stops. As the Circuit-Switcher moves toward the open position, the interrupters will close and the stored-energy source within the brains will charge and latch. The Circuit-Switcher disconnect blades should never be in the closed position when the interrupters are in the open position.

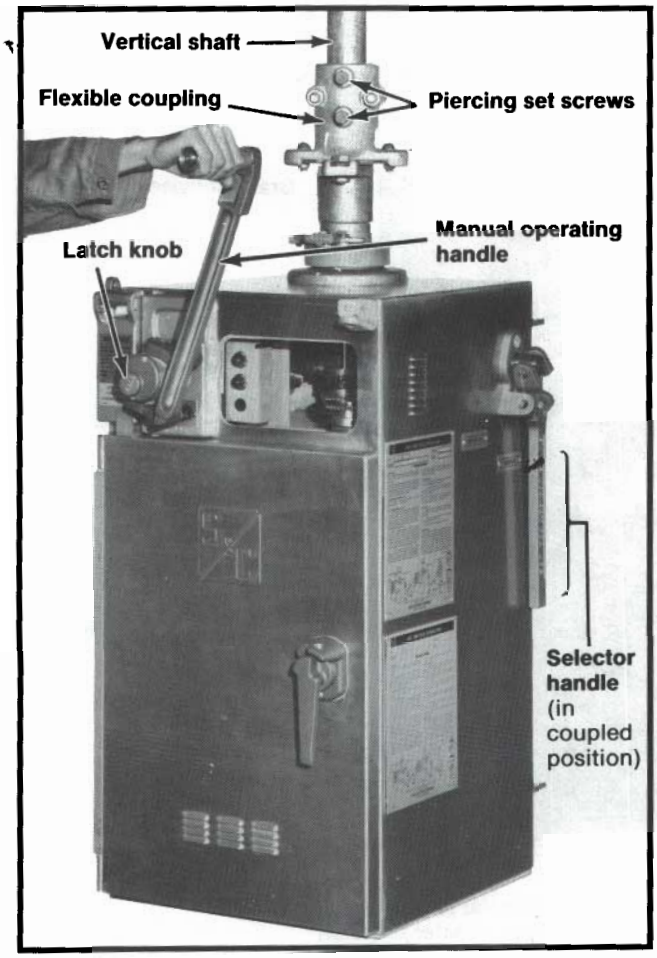


Figure 3. Manual operation.

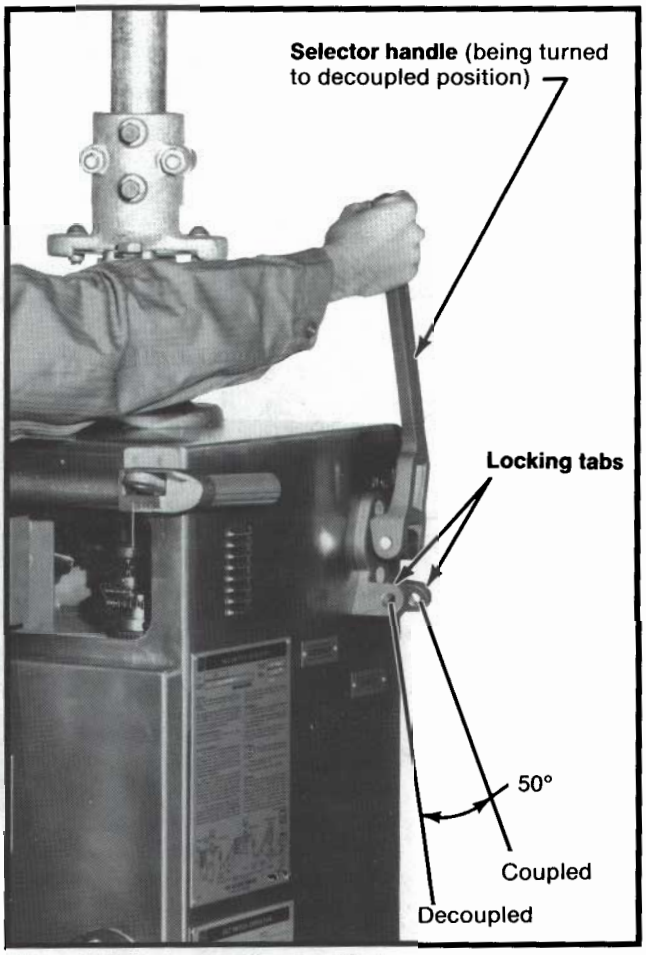


Figure 4. Selector handle operation.

Step 5

To operate manually: Pull the latch knob on the hub of the manual operating handle and pivot the handle forward slightly from its storage position. Release the latch knob while continuing to pivot the handle forward to lock it into the cranking position. See Figures 1 and 3. (As the handle is pivoted forward the motor brake is mechanically released, both leads of the control source are automatically disconnected, and both the "opening" and "closing" motor contactors are mechanically blocked in the open position. However, the shunt-trip device—when this option is provided—remains operative unless the switch operator is in the open position.)

If desired, during manual operation, the switch operator may also be disconnected from the control source by removing the motor-circuit two-pole pull-out fuseholder, located on the right-hand inside wall of the enclosure. Likewise, the shunt-trip device may be rendered inoperative by removing the shunt-trip circuit two-pole pull-out fuseholder, located on the left-hand inside wall of the enclosure.

To return the manual operating handle to its storage position, pull the latch knob and pivot the handle approximately 90 degrees. The handle will then be disengaged from the switch operator and may be rotated freely in either direction to its storage position. Complete the handle storage by pivoting the operating handle backward approximately 90 degrees until it latches in the storage position.

Note that the manual operating handle may be disengaged from the switch operator mechanism at any position of the handle. However, if the switch operator and Circuit-Switcher are at any position between fully open and fully closed when the manual operating handle is placed in the storage position, and the motor-circuit fuseholder is inserted, the switch operator will automatically move to the open position (because the switch operator control circuit is designed to allow an electrical closing only from the fully open position of Circuit-Switcher).

The handle may be padlocked in its storage position.

Step 6

To decouple: The integral external selector handle, for operation of the built-in internal decoupling mechanism, is located on the right-hand side of the switch operator enclosure. See Figure 3. Swing the selector handle upright and *slowly* rotate it clockwise 50 degrees to the decoupled position. See Figure 4. This decouples the switch operator mechanism from the switch operator output shaft. Then lower the selector handle to engage the locking tab. When thus decoupled, the switch operator may be operated either manually or electrically without operating the Circuit-Switcher. When the selector handle is in the decoupled position, the shunt-trip device (when this option is provided) is rendered inoperative.★ Moreover, in the decoupled position, the switch operator's output shaft is prevented from moving by a mechanical locking device located within the switch operator enclosure. During the intermediate segment of the selector handle travel, which includes the position at which actual disengagement (or engagement) of the internal decoupling mechanism occurs, the motor-circuit source leads are momentarily disconnected and both the "opening" and "closing" motor contactors are mechanically blocked in the open position. Visual inspection, through the observation window, will verify whether the internal decoupling mechanism is in the coupled or decoupled position. See Figure 5. The selector handle may be padlocked in either position.

Step 7

To couple: Manually operate the switch operator to bring it to the same position (open or closed) as the Circuit-Switcher. The switch operator position indicator, seen through the observation window, will show when the approximate open or closed position has been attained. (The position indicator for the Circuit-Switcher, located on the output-shaft collar of the switch operator, will be aligned later.) To move the switch operator to the exact position for coupling, turn the manual operating handle slowly until the position-indexing drums are numerically aligned. Then swing the selector handle upright and rotate it counterclockwise to the coupled position. Lower the handle to engage the locking tab. The selector handle is now in the coupled position.

★ Only the shunt-trip device is rendered inoperative. The switch operator can still be opened through the user's protective-relay circuit. Thus "elective" checkout of the system protective scheme is possible at any time.

Step 8

⚠ CAUTION

To avoid accidental energizing of the operator, remove the two-pole pull-out fuseholders for the motor, space-heater, and (if applicable) shunt-trip circuits and do not reinsert them until so directed.

Manually operate the switch operator to bring it to the same position (fully open or fully closed) as the Circuit-Switcher. Tighten the flexible coupling clamp bolts equally so that the clamp pulls down evenly. Then tighten the associated piercing set screws, piercing the shaft, and continue turning until a firm resistance is felt. See Figure 3.

Step 9

With the selector handle in the coupled position, crank the Circuit-Switcher to the fully open position and then to the fully closed position, and in each position accurately align the mechanical Circuit-Switcher position indicators on the output-shaft collar of the switch operator with the alignment arrow below. See Figure 1.

At this time, the drive-shaft crank of each pole-unit of the Circuit-Switcher should be checked to determine that it is in an overtoggle position and against its open or closed stop at the fully open or fully closed position of the switch operator.

⚠ CAUTION

Avoid forcing the power train beyond the fully open or fully closed Circuit-Switcher stop positions. Forced cranking against these stops can build up sufficient spring energy in the vertical and inter-phase shafts to cause the manual operating handle to spin backwards should the grasp on the handle be accidentally released.

Step 10

The cranking direction to close the Circuit-Switcher is indicated by an arrow plate located near the hub of the manual operating handle. See Figure 5. This direction has been predetermined from the erection drawing for the specific installation and has been factory-set accordingly. The direction of rotation of the switch-operator motor has also been set at the factory.

Verify that these directions of rotation are correct as follows:

(a) With the selector handle in the coupled position, manually crank the Circuit-Switcher to the fully open position and then to the fully closed position. Temporarily mark on the top of the switch operator enclosure the direction in which the output shaft rotates to *close* the Circuit-Switcher.

(b) If the cranking direction required to close the Circuit-Switcher is opposite to that indicated by the

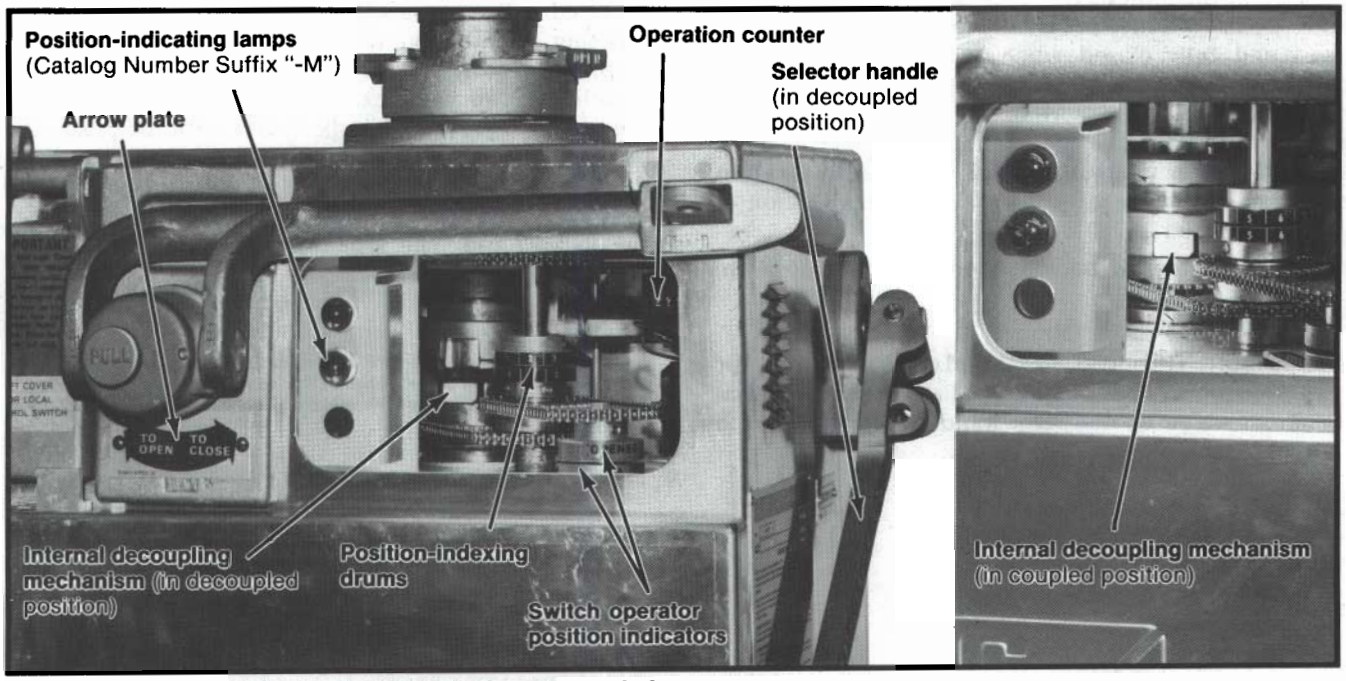


Figure 5. Views of switch operator through observation window.

arrow plate, remove the arrow-plate mounting screws and remount the arrow plate, exposing its opposite side.

(c) With the manual operating handle in its storage position and the *selector handle in the decoupled position*, reinsert the motor-circuit fuseholder. Open the pushbutton protective cover• and operate the switch operator by means of the externally mounted "Open-Close" pushbuttons, if provided, or in their absence, by momentarily jumpering terminals 1 and 8 to open, and 1 and 9 to close.▼ *Note the direction in which the travel-limit discs rotate when the switch operator closes.* The direction should agree with the temporary direction mark previously made on the top of the enclosure and with the direction displayed in the cutaway section on the outer ring of the travel-limit discs. See Figure 6. (As a matter of information, the direction of rotation of the travel-limit discs is always the same as the direction of rotation of the output shaft.)

(d) In the event that the direction of rotation of the travel-limit discs noted in (c) above is opposite to the temporary direction mark previously made in (a) above, a reversal of the motor direction will be necessary. *Remove the motor-circuit fuseholder* to avoid accidental or remote energization of the control circuit. Interchange the "S1" and "S2" motor leads connected to terminals 4 and 5 on the terminal block in the switch operator enclosure.

It should be noted particularly that reversal of the motor direction reverses only the direction of rotation of the output shaft and travel-limit discs. The *identity* of the opening-stroke and closing-stroke travel-limit discs (which will be adjusted later) will remain unaffected.

(e) In the event that the direction of rotation of the travel-limit discs noted in (c) above is opposite to the direction displayed in the cutaway section on the outer ring of the closing-stroke travel-limit disc, remove the positioning screws on the outer ring of the closing-stroke travel-limit disc. See Figure 6. Rotate the outer ring until the desired direction is displayed in the cutaway section. Replace the positioning screws.

(f) Reinsert the motor-circuit fuseholder and operate the switch operator to the open position.

(g) If the direction of output-shaft rotation to open the Circuit-Switcher is opposite to that displayed in the cutaway section on the outer ring of the opening-stroke travel-limit disc, change the direction displayed as indicated in (e) above.

Step 11

The travel-limit switch (coupled to the motor), which governs the extent of output-shaft rotation in the opening and closing directions, includes six contacts that are operated by cam-actuated rollers. Positioning of the cams to properly engage the rollers is facilitated by the travel-limit discs (upper one is the opening-stroke travel-limit disc; lower one is the closing-stroke travel-limit disc).

Adjustment of the opening-stroke travel-limit disc (and therefore the associated cams) is accomplished as follows:

(a) *Remove the motor-circuit fuseholder.*

(b) Place the selector handle in the *coupled* position and manually crank the Circuit-Switcher to the open position.

(c) For the Circuit-Switcher style installed and its number of interrupting gaps per pole-unit, determine from Table I the "Indicator-Plate Number" to which the opening-stroke travel-limit disc is to be rotated. Select the indicator-plate number from the "Opening-Stroke Adjustment—Clockwise to Open" column if the disc and output shaft rotate in the clockwise direction to open the Circuit-Switcher, or from the "Opening-Stroke Adjustment—Counterclockwise to Open" column if the disc and output shaft rotate in the counterclockwise direction to open the Circuit-Switcher.

(d) Grasp the handwheel and turn it to the extent possible in a direction *opposite* to the direction the output shaft rotates to open the Circuit-Switcher. See Figure 6.

(e) With the handwheel held in the position indicated above, raise the opening-stroke travel-limit disc approximately 3/16 of an inch and rotate the disc until the arrow on its outer ring is in line with the number on the indicator plate as specified in Table I. Lower the disc, make sure it is engaged, and release the handwheel.

• For switch operators with optional remote-control blocking switch (suffix "-Y"), opening the pushbutton protective cover prevents remote operation of the switch operator.

▼ Terminal designations may differ in special wiring diagrams. In such cases, refer to the specific wiring diagram for the correct terminal designations.

ADJUSTMENTS — Continued

TABLE I—INITIAL ADJUSTMENT OF TRAVEL-LIMIT DISCS

Circuit-Switcher Style	Number of Interrupting gaps per Pole-Unit	Indicator-Plate Number			
		Opening-Stroke Adjustment		Closing-Stroke Adjustment	
		Clockwise to Open	Counterclockwise to Open	Clockwise to Close	Counterclockwise to Close
Vertical-Break and Center-Break	1	5	5	5	5
	2	6	4	5	5
	3	7	3	5	5
Integer	1	4	6	5	5

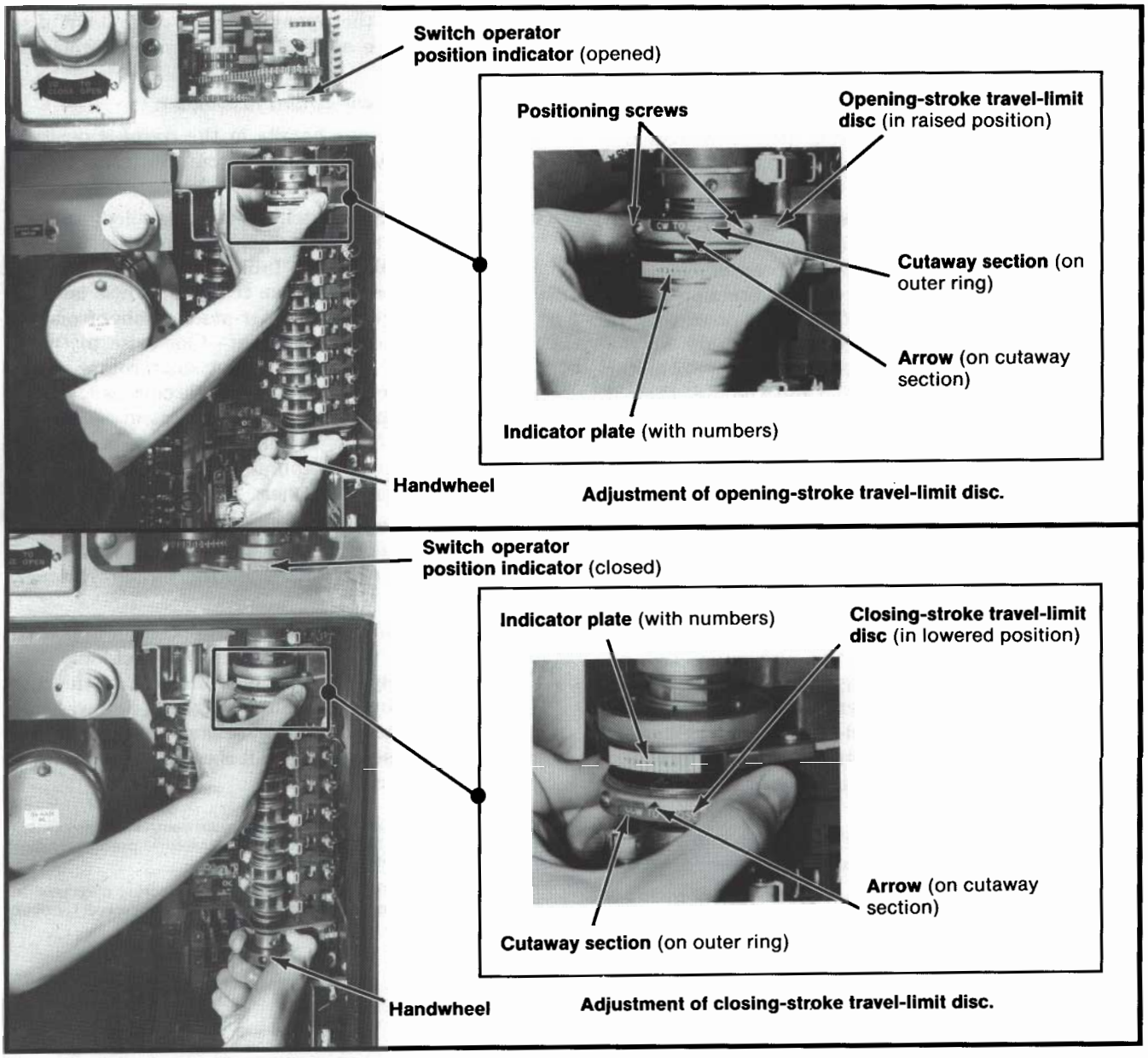

Switch operator position indicator (opened)
Positioning screws
Opening-stroke travel-limit disc (in raised position)
Cutaway section (on outer ring)
Arrow (on cutaway section)
Indicator plate (with numbers)
Handwheel
Adjustment of opening-stroke travel-limit disc.
Switch operator position indicator (closed)
Indicator plate (with numbers)
Closing-stroke travel-limit disc (in lowered position)
Arrow (on cutaway section)
Cutaway section (on outer ring)
Handwheel
Adjustment of closing-stroke travel-limit disc.

Figure 6. Adjustment of travel-limit discs.

Step 12

Adjustment of the closing-stroke travel-limit disc (and therefore the associated cams) is accomplished as follows:

(a) Manually crank the Circuit-Switcher to the fully closed position.

(b) Grasp the handwheel and turn it to the extent possible in a direction *opposite* to the direction the output shaft rotates to close the Circuit-Switcher. See Figure 6.

(c) With the handwheel held in the position indicated above, lower the closing-stroke travel-limit disc approximately 3/16 of an inch and rotate the disc until the arrow on the outer ring is in line with the number 5 on the indicator plate. Raise the disc, make sure it is engaged, and release the handwheel.

Step 13

To preclude the possibility of a malfunction (with resultant possible damage) due to improper adjustment, perform the following check:

(a) *Place the selector handle in the decoupled position.*

(b) Return the manual operating handle to its storage position.

(c) Reinsert the motor-circuit fuseholder.

(d) Operate the switch operator electrically to open and to close as described in Step 10(c). Verify that the rotation direction of the travel-limit discs for opening and closing corresponds with the direction of rotation of the output shaft and that these directions agree with the direction displayed in the cutaway section on the outer ring of the travel-limit discs.

Note that, when electrical operation is performed under the decoupled or "no load" condition, the travel-limit discs do not stop at the indicator-plate positions for which they were previously set in Steps 11 and 12. This may be disregarded.

Step 14

Place the selector handle in the coupled position. Operate electrically to open the Circuit-Switcher and determine the amount of overtravel in the opening direction by releasing the motor brake and noting how far the output shaft "unwinds." (To release the motor brake, unlatch the manual operating handle and pivot it rapidly, with a snap motion, toward its cranking position. Then return the manual operating handle to its storage position.) There should always be a certain amount of "unwind" or relaxation of the output shaft (in both the open and closed positions) to indicate that the Circuit-Switcher has been driven to a positive-toggle position against its open (or closed) stops. If adjustment is needed, remove the motor-circuit fuseholder. To increase the amount of "unwind," retard the opening-stroke travel-limit disc (to increase travel) one indicator-plate number at a time. See Figure 7. Keep in mind that *the direction of disc rotation is always the same as that of the output shaft.* The output shaft *should never* have sufficient "unwind" when the switch operator is decoupled to cause rotation of the travel-limit discs. If rotation of the travel-limit discs is evident, advance the opening-stroke travel-limit disc (to decrease travel) an amount necessary *only* to eliminate the "unwind" rotation of the travel-limit discs.

With the manual operating handle in its storage position, reinsert the motor-circuit fuseholder, and operate the switch operator electrically to close the Circuit-Switcher. Repeat the procedure, as described above and in Figure 7, and adjust the closing-stroke travel-limit disc one indicator-plate number at a time to obtain the correct amount of overtravel in the closing direction.

⚠ CAUTION

Before checking the "unwind" after a closing stroke, remove the motor-circuit fuseholder before releasing the motor brake. Excessive "unwind" at this point could cause rotation of the travel-limit switch sufficient to pick up a "bb" contact which, in turn, would cause the switch operator to open (if energized).

Step 15

Operate the Circuit-Switcher several times electrically with the switch operator and observe the action. Operation should appear smooth, with the Circuit-Switcher drive-shaft cranks coming to rest firmly

against their stops, in an overtoggle position, in both opening and closing directions.

If necessary, realign the Circuit-Switcher position indicators on the switch operator output-shaft collar with the alignment arrow.

With the switch operator in the fully open position and then in the fully closed position, check the corresponding switch operator position indicator. In each position the corresponding position indicator should be readily visible from the front of the enclosure. If adjustment of either position indicator is necessary, remove the motor-circuit fuseholder, loosen the two set screws (see Figure 9), and rotate the indicator to the desired position. Retighten the set screws.

Step 16

The auxiliary switch, which is permanently coupled to the motor, includes eight contacts (terminals 11 through 26). (If the optional position-indicating lamps are included, six contacts are available: terminals 13 through 18 and terminals 21 through 26.) These contacts are provided so that external circuits can be established to monitor switching operations. Each contact is operated by a cam-actuated roller. The cams are individually adjustable in 4.5-degree increments and can be positioned so that roller engagement occurs at the desired point in the operating cycle.

The "standard" configuration for the auxiliary switch consists of four "a1" contacts (terminals 11 through

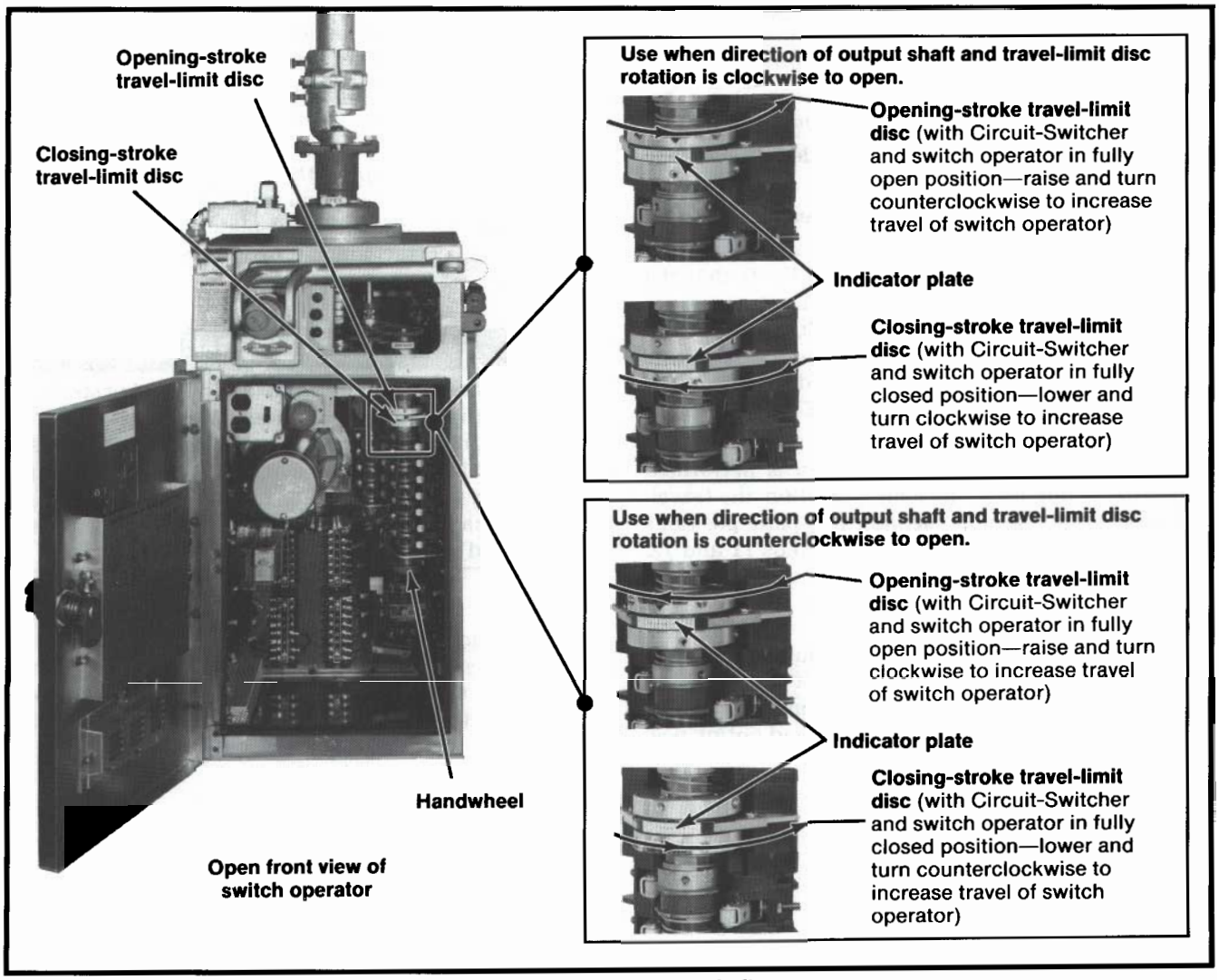

Opening-stroke travel-limit disc
Closing-stroke travel-limit disc
Handwheel
Open front view of switch operator
Use when direction of output shaft and travel-limit disc rotation is clockwise to open.
Opening-stroke travel-limit disc (with Circuit-Switcher and switch operator in fully open position—raise and turn counterclockwise to increase travel of switch operator)
Indicator plate
Closing-stroke travel-limit disc (with Circuit-Switcher and switch operator in fully closed position—lower and turn clockwise to increase travel of switch operator)
Use when direction of output shaft and travel-limit disc rotation is counterclockwise to open.
Opening-stroke travel-limit disc (with Circuit-Switcher and switch operator in fully open position—raise and turn clockwise to increase travel of switch operator)
Indicator plate
Closing-stroke travel-limit disc (with Circuit-Switcher and switch operator in fully closed position—lower and turn counterclockwise to increase travel of switch operator)

Figure 7. Adjustment of travel-limit discs for desired "unwind" of output shaft.

18) and four "b1" contacts (terminals 19 through 26). Thus, with the switch operator in the open position, the "a1" contacts are open and the "b1" contacts are closed. Conversely, with the switch operator in the closed position, the "a1" contacts are closed and the "b1" contacts are open. A contact is closed if its roller is disengaged from a cam, and conversely, a contact is open if its roller is engaged by a cam. See Figure 9.

Any auxiliary-switch contact being used must be checked for proper operation *after* the switch operator travel-limit discs have been adjusted. Check the auxiliary-switch contacts for both open and closed positions of the switch operator. To adjust the auxiliary-switch contacts, refer to Figures 8 and 9 and proceed as follows:

(a) With the selector handle in the coupled position, operate the switch operator to the fully closed position (manually or electrically).

(b) *Remove the motor-circuit fuseholder.*

(c) Determine which "a1" contacts are not in the closed position. A contact is closed if its roller is disengaged from a cam, and conversely, a contact is open if its roller is engaged by a cam.

(d) For the "a1" contacts that are not in the closed position, raise (or lower) the corresponding cam toward its adjacent spring until the cam is separated from the teeth of the inner gear. Rotate the cam until it is in a position so that when lowered (or raised) it will be disengaged from the roller. Lower (or raise) the cam making sure that the teeth are in mesh with the inner gear and that the cam is disengaged from the roller.

(e) Reinsert the motor-circuit fuseholder.

(f) Operate the switch operator to the fully open position. *Remove the motor-circuit fuseholder* and, if necessary, adjust the cams as described in (d) above until all "b1" contacts are in the closed position.

(g) Reinsert the motor-circuit fuseholder and operate the Circuit-Switcher. Both sets of contacts should now be correctly positioned for both the open and closed position of the Circuit-Switcher. Sufficient adjustment is available to provide correct positioning of both sets of contacts.

Since each cam can be individually adjusted in 4.5-degree increments, any "a1" contact can be changed to a "b1" contact, or vice versa. Also, because of the many positions to which the cams can be adjusted, the various rollers can be engaged or disengaged to respectively open or close their contacts simultaneously, sequentially, randomly, or in various combinations. Adjustment of the auxiliary switch for other than the "standard" contact configuration is left to the user. Remember that the motor-circuit fuseholder *should be removed* when adjusting these contacts. (Switch operators having catalog numbers with the suffix "-Q" are equipped with an extra auxiliary switch, terminals 27 through 34, having four contacts—two "a1" and two "b1"—which may be adjusted as described in (a) through (g) above. See Figure 9.)

Step 17

Switch operators having catalog numbers with either the suffix "-W" or "-Z" are equipped with an extra auxiliary switch which is coupled to the Circuit-Switcher. The suffix "-W" auxiliary switch consists of eight contacts (terminals 35 through 50). The suffix "-Z" auxiliary switch consists of twelve contacts (terminals 35 through 50 plus terminals 80 through 87). These contacts are provided so that external circuits can be established to monitor Circuit-Switcher operation. Each contact is operated by a cam-actuated roller and the cams are individually adjustable in 4.5-degree increments.

The "standard" configuration for the suffix "-W" extra auxiliary switch consists of four "a2" contacts (terminals 35 through 42) and four "b2" contacts

(terminals 43 through 50). The "standard" configuration for the suffix "-Z" extra auxiliary switch consists of six "a2" contacts (terminals 35 through 42 and terminals 80 through 83) and six "b2" contacts (terminals 43 through 50 and terminals 84 through 87). Thus, with the Circuit-Switcher in the fully closed position, the "a2" contacts should be closed and the "b2" contacts should be open. Conversely, with the Circuit-Switcher in the fully open position, the "a2" contacts should be open and the "b2" contacts should be closed. See Figure 9.

Any suffix "-W" or "-Z" auxiliary-switch contact being used must be checked for proper operation after satisfactory electrical operation of Circuit-Switcher has been achieved. Check the auxiliary-switch contact engagement for both the open and closed positions of the Circuit-Switcher. Adjustment of the suffix "-W" or "-Z" extra auxiliary switch is identical to the adjustment performed for the auxiliary switch and the suffix "-Q" extra auxiliary switch. Therefore, if adjustment of the suffix "-W" or "-Z" auxiliary switch is needed, refer to Step 16 and Figures 8 and 9.

Step 18

Reinsert the fuseholders for the motor, space-heater, and (if applicable) shunt-trip circuits.

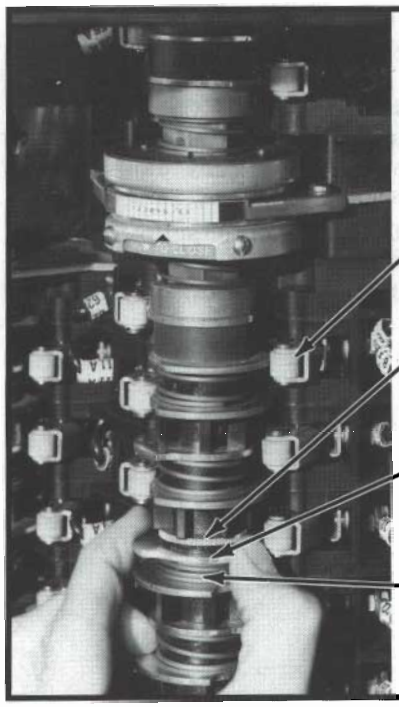


Figure 8. Adjustment of cams on auxiliary switch.

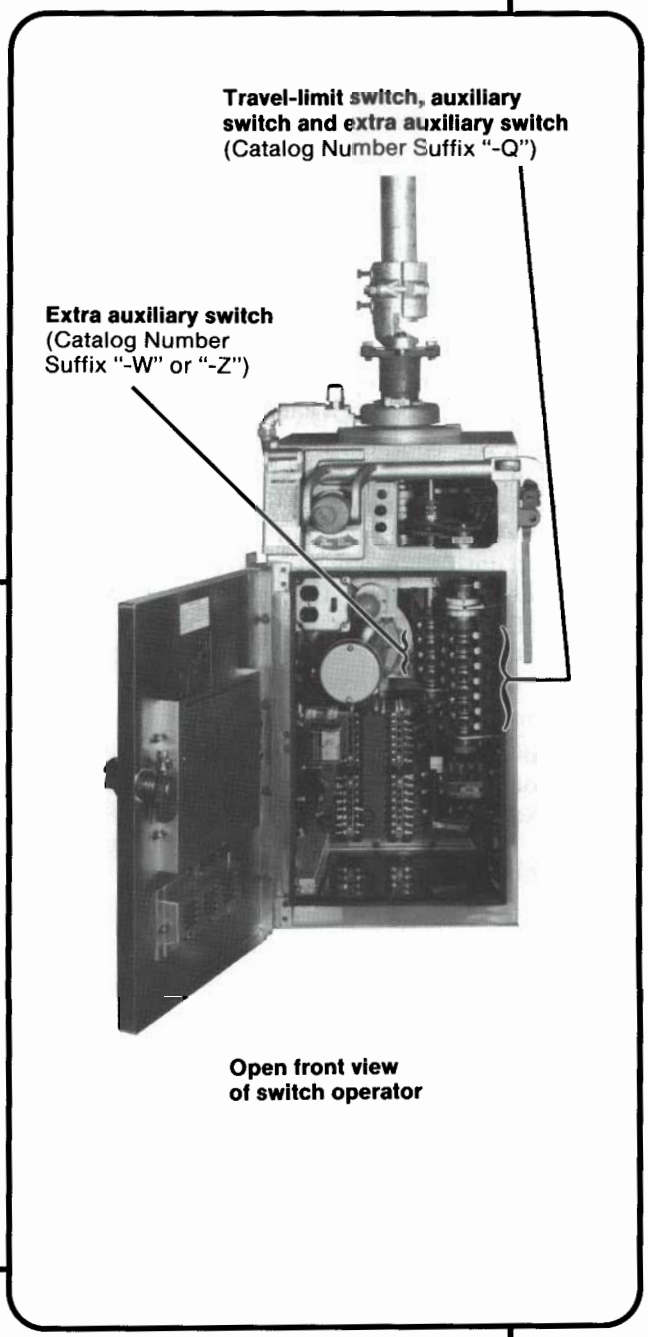
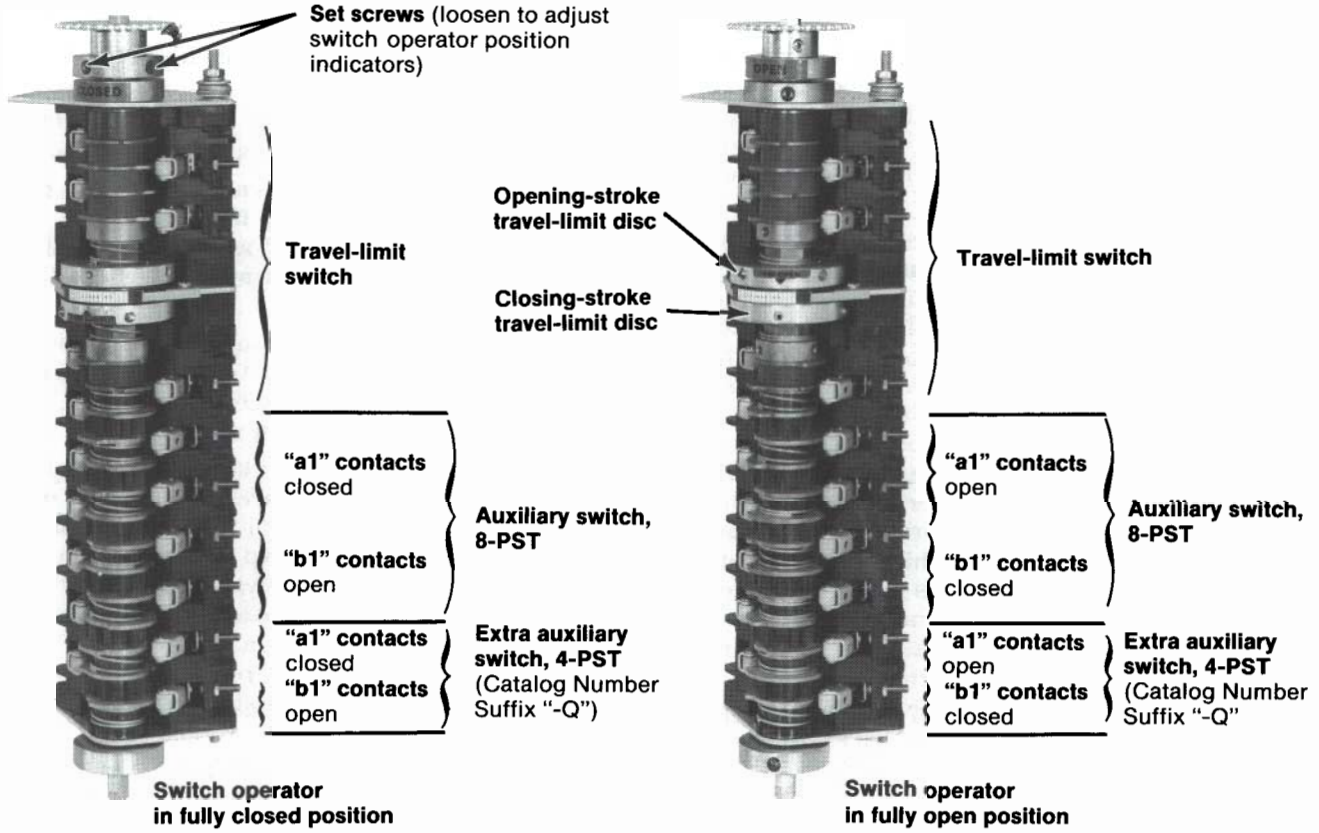
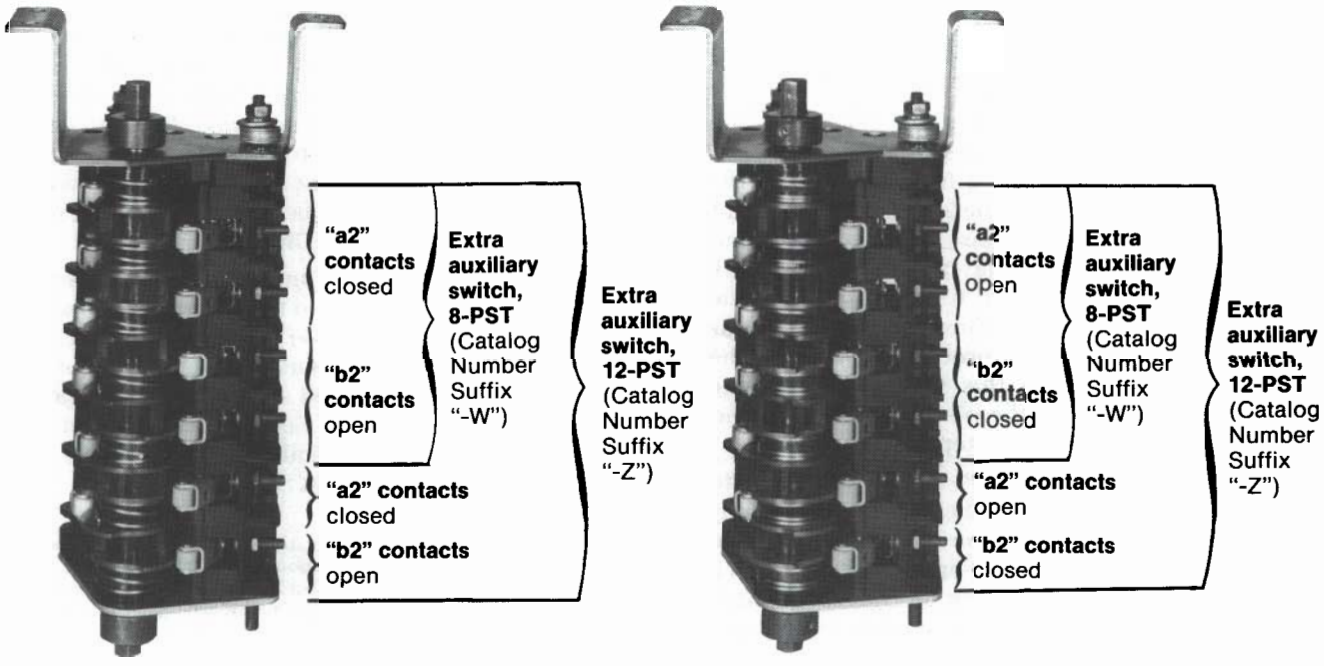

Travel-limit switch, auxiliary switch and extra auxiliary switch (Catalog Number Suffix "-Q")
Extra auxiliary switch (Catalog Number Suffix "-W" or "-Z")
Open front view of switch operator

Figure 9. "Standard" contact configurations.


Set screws (loosen to adjust switch operator position indicators)
Travel-limit switch
"a1" contacts closed
"b1" contacts open
Auxiliary switch, 8-PST
"a1" contacts closed
"b1" contacts open
Extra auxiliary switch, 4-PST (Catalog Number Suffix "-Q")
Switch operator in fully closed position
Opening-stroke travel-limit disc
Closing-stroke travel-limit disc
Travel-limit switch
"a1" contacts open
"b1" contacts closed
Auxiliary switch, 8-PST
"a1" contacts open
"b1" contacts closed
Extra auxiliary switch, 4-PST (Catalog Number Suffix "-Q"
Switch operator in fully open position


"a2" contacts closed
"b2" contacts open
Extra auxiliary switch, 8-PST (Catalog Number Suffix "-W")
"a2" contacts closed
"b2" contacts open
Extra auxiliary switch, 12-PST (Catalog Number Suffix "-Z")
Circuit-Switcher in fully closed position
"a2" contacts open
"b2" contacts closed
Extra auxiliary switch, 8-PST (Catalog Number Suffix "-W")
"a2" contacts open
"b2" contacts closed
Extra auxiliary switch, 12-PST (Catalog Number Suffix "-Z")
Circuit-Switcher in fully open position

INSPECTION SCHEDULE AND PROCEDURES

To assure continued proper performance of Circuit-Switcher and Type CS-1A Switch Operator, they should be inspected in accordance with S&C's recommended schedule and procedures contained in S&C Instruction Sheet 711-590. (These procedures, incidentally, take the place of the annual exercising which has, up until the October 28, 1985 issuance of Instruction Sheet 711-590, been recommended for Circuit-Switcher and its operator.★)

Should the user wish to perform elective exercising of the complete Circuit-Switcher installation—including the shunt-trip device, when this option is furnished—it may be accomplished without the need for opening the high-voltage circuit, by equipping the Circuit-Switcher with the optional stick-operated bypass accessory (Catalog Number Suffix "-B1" or "-B2"). Even if the bypass accessory has not been furnished, the Type CS-1A Switch Operator may be conveniently decoupled from the Circuit-Switcher, thereby permitting elective exercising of the operator at any time without requiring an outage or switching to an alternate source; when the switch operator is in the decoupled position, the shunt-trip device—when this option is furnished—is rendered inoperative, thereby permitting checkout of the system protective scheme.

As indicated in Instruction Sheet 711-590, the brake in the Type CS-1A Switch Operator should be inspected every 2500 operations or 5 years, whichever occurs more often. The inspection procedure is as follows. See Figure 10.

1. Place the selector handle in the decoupled position.
2. Remove the two-pole pull-out fuseholders for the motor, space-heater, and (if applicable) shunt-trip circuits.
3. Disconnect the linkage rod by removing the ¼″—20 × 1¼″ hex-head screw, lockwasher, flat washer, and spacer-bushing from the end of the brake lever, as shown in Detail A. Be careful not to lose these parts. Then raise the brake lever and measure the vertical free play, as shown in Detail B. This dimension should be ⅝″ to ¾″. Should the measurement be outside this range, brake-wear compensation is required; proceed to Step 4. If the measurement is within this range, reattach the linkage rod and tighten the ¼″—20 × 1¼″ hex-head screw securely; proceed to Step 9.
4. Remove the four 5/16″—18 × 1¼″ screws used to attach the motor, withdraw the motor, and carefully rest its shaft on the floor of the enclosure. Be careful not to lose the square key or tubular spacer (if furnished), which may remain on the motor shaft. Note: 115-volt ac and 230-volt ac motors utilize a ¼″—20 socket-head set screw on the side of the brake disc hub, as shown in Detail C. Loosen this set screw approximately one-half turn, using a ⅛″ Allen wrench, before removing the motor.
5. Using a 3/32″ Allen wrench, loosen the pad assembly socket-head set screw on the side of the caliper assembly approximately one-half turn. See Detail A.
6. Then, using a 5/16″ Allen wrench, rotate the pad assembly clockwise until the free play at the end of the brake lever is ⅝″ to ¾″, as shown in Detail B. Now tighten the 3/32″ pad assembly socket-head set screw.
7. Insert the spacer-bushing through the angle bracket and brake lever, and reattach the linkage rod using the ¼″—20 × 1¼″ hex-head screw, lockwasher, and flat washer. Tighten the screw securely.
8. Insert the square key in the keyway, as shown in Detail A. Slip the tubular spacer (if furnished) over the motor shaft and reinstall the motor. Position the motor such that the two weep holes on the side of the housing face downward. Replace the four 5/16″—18 × 1¼″ screws used to attach the motor and tighten them securely. On 115-volt ac and 230-volt ac motors, further, retighten the ¼″—20 socket-head set screw on the side of the brake disc hub.
9. Check the operation of the brake linkage as follows: Pull the latch knob on the hub of the manual operating handle and *slowly* pivot the handle forward from its storage position toward its cranking position until the brake disc can be rotated by hand. *Be careful not to get grease on the brake disc.* Now measure the distance that the end of the brake lever travels from the point of initial brake release to the bottom of its stroke (which occurs when the handle locks into the cranking position). This dimension should be ⅛″ to ¼″. See Detail D. Should the measurement be outside this range, refer to the nearest S&C Sales Office.
10. Finally, to check the functioning of the brake, decouple the operator and then open and close the operator electrically. After each operation, check the position of the indicator on the appropriate travel-limit disc: it should stop between indicator-plate numbers 2 and 8. See Figure 6. Should the indicator on the travel-limit disc stop outside this range, refer to the nearest S&C Sales Office.

★ Superseded-design switch operators, Catalog Numbers 38846 through 38846R3, equipped with optional shunt-trip solenoid switch and redundant relay (Catalog Number Suffix "-HP") should continue to have these components exercised annually. See page 20.

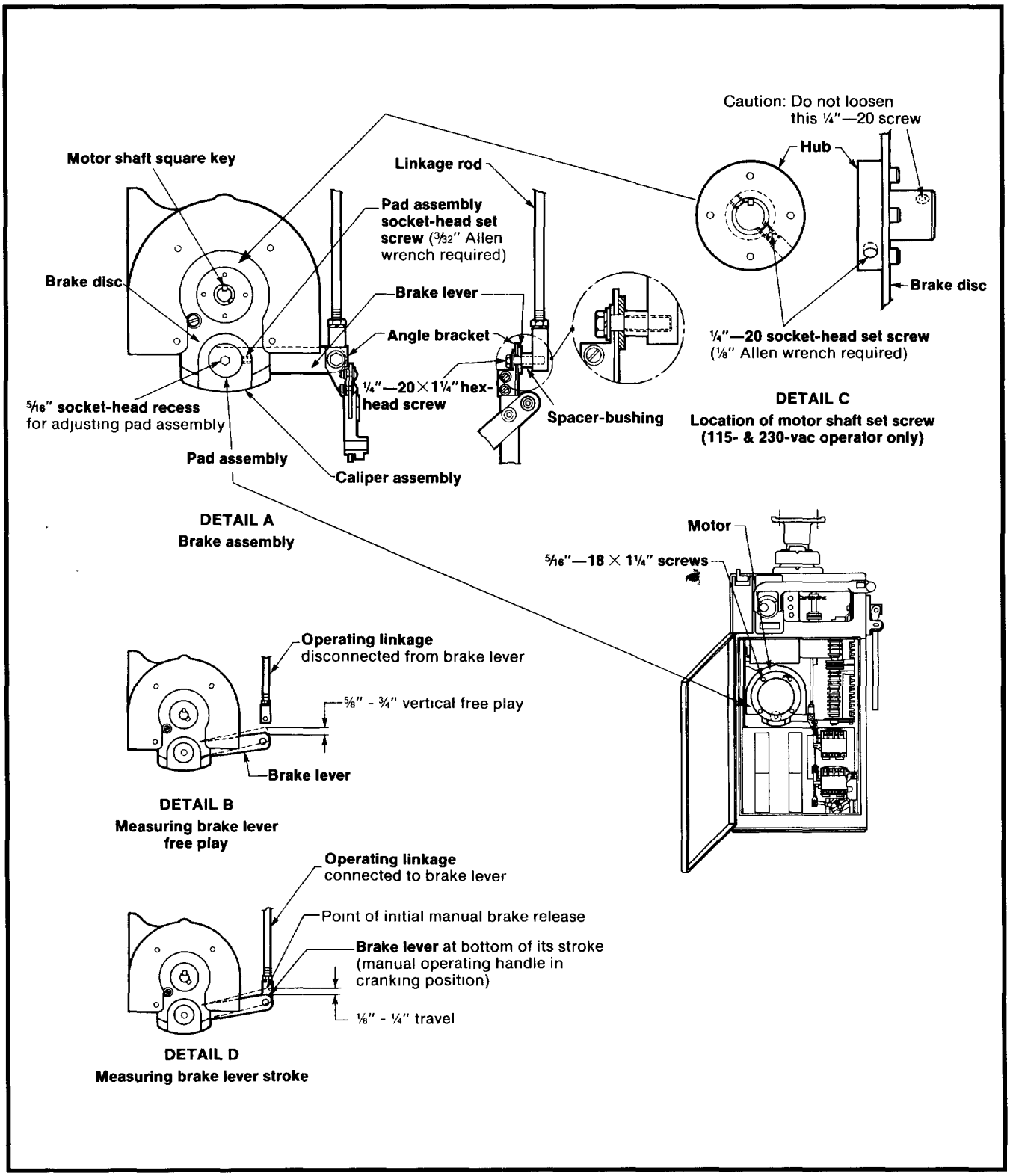

Caution: Do not loosen this ¼"—20 screw
Hub
Brake disc
¼"—20 socket-head set screw (⅛" Allen wrench required)
DETAIL C
Location of motor shaft set screw (115- & 230-vac operator only)
Motor shaft square key
Linkage rod
Pad assembly socket-head set screw (3⁄32" Allen wrench required)
Brake disc
Brake lever
Angle bracket
¼"—20 × 1¼" hex-head screw
Spacer-bushing
5⁄16" socket-head recess for adjusting pad assembly
Pad assembly
Caliper assembly
DETAIL A
Brake assembly
Motor
5⁄16"—18 × 1¼" screws
Operating linkage disconnected from brake lever
⅝" - ¾" vertical free play
Brake lever
DETAIL B
Measuring brake lever free play
Operating linkage connected to brake lever
Point of initial manual brake release
Brake lever at bottom of its stroke (manual operating handle in cranking position)
⅛" - ¼" travel
DETAIL D
Measuring brake lever stroke

Figure 10. Brake inspection procedure.

Recommended Exercising Procedure for Superseded-Design Switch Operators, Catalog Numbers 38846 through 38846R3, Equipped with Optional Shunt-Trip Solenoid Switch and Redundant Relay (Catalog Number Suffix "-HP")

In these superseded-design switch operators, a shunt-trip solenoid switch (94) and redundant relay (62) are utilized to minimize control-current inrush, by energizing the shunt-trip device and switch operator motor in sequence; the redundant relay provides a backup function, ensuring Circuit-Switcher actuation independent of shunt-trip operation. To verify their proper functioning, it is recommended that the shunt-trip solenoid switch and redundant relay each be exercised separately (preferably through the protective-relay circuit, to check out the external control wiring as well) while the other component is temporarily disabled.

The following annual exercising procedure is recommended. (Note that the wire and terminal designations referenced apply to the standard wiring diagrams for these superseded models—CDR-3116R3-1 and CDR-3116R3-2—and may differ on special wiring diagrams.)

To exercise the shunt-trip solenoid (94) switch:

1. Open the control-source disconnect switch; then place the switch operator selector handle in the *decoupled* position. (When the switch operator is thus decoupled, the shunt-trip solenoids at the Circuit-Switcher pole-units are rendered inoperative.)
2. Disable the opening contactor (OC) by removing wires numbered 8C and 8D from the opening-contactor (OC) coil terminal C7. This will allow the opening operation of the switch operator to be totally controlled by the contacts of the solenoid (94) switch.
3. Close the control-source disconnect switch and energize the solenoid (94) switch (to move the switch operator to the open position) by a simulated shunt-trip operation. Return the switch operator to the closed position by means of the pushbutton control. Repeat four times for exercising purposes.
4. Open the control-source disconnect switch and reconnect wires numbered 8C and 8D to the opening-contactor (OC) coil terminal C7.

To exercise the redundant (62) relay:

1. Make sure that the control-source disconnect switch is opened and the switch operator selector handle is in the *decoupled* position.
2. Disable the solenoid (94) switch by removing wire number 2I from terminal L1 on the redundant (62) relay. This will allow an opening operation of the switch operator to be initiated by the contacts of the redundant (62) relay.
3. Close the control-source disconnect switch and energize the redundant (62) relay (to move the switch operator to the open position) by a simulated shunt-trip operation. Energization should be for a duration of more than ¼ second to allow time for closing of the (62) relay contact. Return the switch operator to the closed position by means of the pushbutton control. Repeat four times for exercising purposes.
4. Open the control-source disconnect switch and reconnect wire number 2I to the redundant (62) relay terminal L1.
5. To return the switch operator to service, bring the switch operator to the same position as the Circuit-Switcher; place the selector handle in the coupled position; and close the control-source disconnect switch.

CHECKING SWITCH OPERATOR AND CIRCUIT-SWITCHER POSITIONS

Do not assume that the switch operator position necessarily indicates the open or closed position of the Circuit-Switcher. Upon completion of an opening or closing operation (electrical or manual), check to be sure that the following conditions exist:

- The switch operator position indicator, Figure 5, signals "Open" or "Closed" to indicate that the switch operator has moved through a complete operation. Also note the position-indicating lamps, Figure 5, if furnished.
- The Circuit-Switcher position indicator, located on the switch operator output shaft, Figure 1, is in agreement with the switch operator position indicator. That is, both indicators should show "Open" or "Closed."
- The Circuit-Switcher disconnect blade on each pole-unit is fully open or fully closed.

Then tag and padlock the switch operator in accordance with standard system operating procedures. In all cases, make certain that the switch operator is padlocked before "walking away."

Correct operation of the Circuit-Switcher depends on charging and latching the stored-energy source within each brain as the disconnect blades move to the fully open position and the interrupters close. The interrupter target located on the side of each brain housing appears yellow when the interrupter is open. The target appears gray (normal) when the interrupter is closed.

Because the interrupters are closed as the Circuit-Switcher blades move to the fully open position, the target appears yellow only briefly during the opening operation. The target should never appear yellow when the Circuit-Switcher is in the fully open or fully closed position.

To restore to normal operation

So that the switch operator is ready for normal power operation of Circuit-Switcher by remote automatic or supervisory control, be sure that the following conditions exist:

- The selector handle is in the coupled position.
- The manual operating handle is in its storage position.
- The two-pole pull-out fuseholders for the motor, space-heater, and (if applicable) shunt-trip circuits are inserted.
- The pushbutton protective cover is closed.
- The switch operator is tagged and padlocked in accordance with standard system operating procedures.